Design and Analysis of Algorithms - Final Overview

You should be able to sufficiently justify why any algorithm or data structure operation has the time complexity it does.

Fundamental Techniques
- Greedy Method (greedy choice, greedy-choice property)
- Divide and Conquer (divide, recur, conquer, recurrence equations, Master Theorem)
- Dynamic Programming (define subproblems, subproblem optimality, subproblem overlap, bottom-up, table)
- Algorithms/Problems include:
    - Fractional knapsack (greedy)
    - Task Scheduling (greedy)
    - Merge sort (divide and conquer)
    - I won't ask you about integer multiplication (divide and conquer)
    - Matrix Chain Multiplication (dynamic programming)
    - 0-1 Knapsack Problem (dynamic programming)

Graphs
- Definitions: graph, vertex, edge, directed, weighted, vertex degree, adjacent, incident, path, simple path, cycle, simple cycle, subgraph, spanning subgraph, connected graph, connected components, spanning trees, forest, biconnected graph, biconnected components, separation vertex and separation edge, handshaking lemma, bound on number of edges
- Data structures include: edge list, adjacency list, adjacency matrix
- Algorithms/Problems include:
    - Graph traversals DFS & BFS (discovery & non-discovery edges)
    - Variations/applications of DFS & BFS to find connected components, spanning forest, path, shortest path, cycle, if graph is connected, biconnected components

Digraphs
- Definitions: digraph, in-degree, out-degree, directed path, reachability, strong connectivity, directed cycle, DAG, topological order, transitive closure
- Algorithms/Problems include:
    - Digraph traversals DFS & BFS
    - Test for strong connectivity
    - Find transitive closure using Floyd-Warshall's algorithm
    - Find a topological order

Weighted Graphs
- Definitions: weighted graph, single source shortest path problem formulation, shortest path tree, all pairs shortest path, minimum spanning tree
- Algorithms/Problems include:
    - Single source shortest path using Dijkstra's, Bellman-Ford, and shortest path in DAGs
    - All pairs shortest path using Floyd-Warshall's algorithm
    - Find minimum spanning tree using Prim-Jarnik's, Kruskal's, and Baruvka's algorithm

Maximum Flow
- Definitions: edge capacity, flow network, source, sink, flow, cut, flow over cut, capacity of a cut, maximum flow problem formulation, flow augmentation and augmenting path
- Max-Flow and Min-Cut Theorem
- Algorithms/Problems include:
    - Find maximum flow using Ford-Fulkerson's and Edmonds-Karp algorithm